ON THE FEEDBACK PROCESS BETWEEN NASA AND ITS ENVIRONMENT

A Report Prepared for the
National Aeronautics and Space Administration
Under NASA Grant NGL 10-007-067, Supplement 1

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July 18, 1969

INTRODUCTION

This report has been prepared and is submitted to NASA in the thought that it will be helpful not only in connection with ongoing appraisals of impacts of NASA programs but also as a sort of basic "position paper" with respect to NASA's policies, purposes and activities in the area of interaction between NASA's programs and activities and the environment.

In carrying forward our studies of the impacts of NASA's programs through the analytical utilization of data obtained from the NASA sub-contracting information system, we have felt it necessary for the structuring of our work to search out basic aspects of NASA's objectives, policies, and needs with respect to information for this area. We have also felt it necessary to examine the adequacies and inadequacies of informational systems and practices as against these objectives, policies and needs.

We have found as we pursued our research that NASA management has developed an imaginative and innovative yet soundly based body of doctrine regarding NASA informational requirements as against the environment. This body of doctrine encompasses a clearly articulated conceptual framework, a comprehensive set of objectives, a range of policy statements and guidelines relative both to a general approach and to specific situations and problems, and feedback from management as against ongoing practices and in response to feedback emanating from the environment. However--and this strikes us as most important--the varied elements of this body of doctrine have never been brought together in one document, or even in an easily identifiable series of documents. We have had to look to speeches, memoranda exchanged within top management, testimony before Congress, and to

various other documents and statements scattered throughout the Agency. To illustrate the situation and its consequences: A statement of basic policy has often been contained in operational memoranda addressed by the Administrator or other high level official to particular individuals in connection with immediate and often one-shot operational problems or activities, as for example a congressional inquiry or a reaction to informational material submitted for review; such memoranda have more often than not simply served their immediate purposes and then been more or less "lost" in the files; they have seldom been singled out by recipients or other responsible individuals for incorporation into the mainstream of policy guidances within the agency. We believe that this sort of thing has resulted in something of a communications gap between top management and operational elements in the Agency with regard to informational policies, guidance, purposes, etc., and in a loss of effectiveness in the implementation of policies. This report, we feel, will help to remedy this situation.

We have also found that informational systems within NASA are well designed to meet NASA's requirements and purposes with regard to the collection, analysis and effective presentation of data relative to the direct and immediate impacts of NASA's programs and activities on the environment. At the same time, however, we have found that these systems are not utilized to the extent they might be in the implementation of the range of NASA's policies. For one thing, the systems have tended to become "frozen" into requirements as they were when the systems were instituted and have not been imaginatively adapted to new and more complex requirements that have emerged as NASA programs have matured and as public attitudes and concerns regarding space activities and their significance for society have changed. For another, we have found that informational services suffer from a lack of awareness among those responsible for informational matters of

many valuable informational resources available in the Agency. We have found further and most important that from the standpoint of the broad socioeconomic impacts as distinct from direct or "dollar outlays" impacts and particularly impacts involving second and third order effects informational efforts within the Agency and on behalf of the Agency by outside contractors and grantees have been poorly responsive to the policies and needs of the Agency as defined by top management.

In making these comments, we feel it important to note that the concept of feedback as against the environment entails several dimensions. First, there must be a communication between program and public. Second, there must be communication of the public's need for information to the agency. Third, there must be communication within the Agency regarding needed changes in course in response to public attitudes and in order both to develop proper informational policies and to insure that information is at the point of need at the time of need. The keystone of this communication is necessarily the Administrator of NASA. Basic to its effectiveness is a strong flow of information from information gatherers and analysts within the Agency to top management and also from top management back to the gatherers and analysts. On the success of this flow depends the success of management in reporting on the program.

In NASA's case, where the need for public support is very strong, the organization must keep the public informed continually of what is going on so that the public will maintain its interest. By pointing out to the public the benefits it receives because of NASA's very presence, the public tends to remain supportive. As a nation, we certainly have some notions of the importance of the space program in terms of national defense, national prestige, and so on. But as a nation we are easily subject to a shifting of national goals. When something else catches the public eye, the programs

that need constant support, not just support when a crisis occurs, can easily and quickly lose ground.

In a local area, the persons working directly with the program are aware of its effects on them and its importance to them. However, what about those persons whose daily lives give them no direct contact? Can they be made aware of how much they are touched by the second and third order consequences? Can they be made aware of the fact that a strong employment base gives a feeling of stability which, in turn, draws stable individuals to the area; that stable individuals who plan to stay in an area are the ones who will be concerned with the area and are beneficial to it?

It is the development of this sort of awareness that we believe to be important in future NASA social research. In order for this country to maintain its commitment to space, its awareness of the program must be kept on an even level. The peak of public awareness was accomplished in the early 60's. NASA found that the lunar landing captured the public fancy--and we are now on the brink of achieving that goal we so desired. However, the optimum situation in the 70's would be to divert the public from its thinking in terms of a series of short-term goals to seeing the space program as a firm part of the American scene.

ON THE FEEDBACK PROCESS BETWEEN NASA AND ITS ENVIRONMENT

I The Conceptual Basis and the Requirement

While NASA's most striking symbol of success in the effort to make this country preeminent in space is the achievement of the moon goal, behind this are many other success stories. One, of course, is that NASA has attained, and more difficult and important maintained over ten years, broad-based public support for the space endeavor. A key factor in this has been a systematic effort on the part of NASA (1) to so administer and manage its activities as to benefit society as a whole, rather than one element or sector, and from the standpoint of secondary and tertiary effects as well as primary, and (2) to report to the public and its representatives in Congress on these activities and their consequences and at times when the public has wanted to know about them and in terms that can be understood. This constant concern with regard to both the impact of NASA programs and activities and an effective feedback operation as against the political processes of the nation was the product of a deliberate policy on the part of NASA leadership. The philosophy underlying this was spelled out by former Administrator Webb in the 1968 McKinsey lectures at Columbia University. Webb's points, which evidently reflect the broad experiences of the NASA operation as a whole, appear worthy of noting in detail.

. . . Speaking of large programs, of which NASA has been one, they are ordinarily undertaken as a result of a significant change in the environment --social, political, technological, military, or other--that raises a new and urgent need or presents a significant new opportunity. The establishment

of the transcontinental railway system came from a combination of new technology and driving changes in the economic and social life of the country. The Polaris and other missile programs were dictated by a threatened shift in the balance of strategic military power. The Tennessee Valley Authority came from the ravages of depression and the opportunity to minimize the region's relief drain on the budget, coupled with the opportunity to effect a quantum jump through using new technology in the exploitation of great natural resources of the area.

. . . interaction between the environmental situation and large-scale endeavors is a continuous and often turbulent process. As changes in the environment produce the endeavor, so do subsequent changes work for continuing modifications in the nature of the job being done and in the tools needed and available to do it. Pressures may arise from what happens in the endeavor itself. Or they may have other sources as, for example, the rise of new competing demands on scarce resources, growing effectiveness of a dissenting minority, a change in popular attitudes, or a change in the political balance. This means that for each large-scale endeavor there is a critically important need for continuing feedback of information regarding the environment, and, at the same time, sufficient flexibility in organizational structure and management processes enable the enterprise to ride out unexpected turbulence . . . .

. . . communications are of unusual importance, particularly communications related to the collection and use of feedback. Enormous quantities of data are indispensable, but this in its turn creates a special problem of unwanted data or "noise" and possibilities of confusion. The need is for a sure means to select what is needed when it is needed and where it is needed.

. . . another common denominator of large-scale endeavors is the

necessity of a continuing "critical mass" of support. There must be enough support and continuity of support to retain and to keep directly engaged on the critical problems the highly talented people required to do the job, as well as to keep viable the entire organizational structure. As with an airplane, the initial support must be adequate to attain the equivalent of "flying speed," and support must continue at a tempo and at a level adequate to maintain the equivalent of an efficient flight path. Any uncertainty or shortfall in the support factor is apt to have far-reaching effects on the result and force the endeavor into serious difficulties.

. . . all large-scale endeavors have important secondary and tertiary effects beyond those associated with the prime objective. These alter the environment and significantly impact events generally. Whether primarily private or public in nature, large-scale endeavors produce social and sometimes political consequences of lasting importance.

. . . they are essentially investment enterprises representing a willingness of a group or a society to give up resources in hand for future returns that may be long delayed in realization. They are ordinarily unusually challenging from the standpoint of their uniqueness, their promise, or the urgency of their need, and they tend to appeal to creative instincts on the part of supporters and participants. Conversely, as new ways of doing things, they are prone to generate resistance or dissent.

. . . large-scale endeavors, whether public or private, invariably loom large in the public eye. They are subject to constant watchfulness on the part of supporter and opponent alike. Today they must operate under the glare of TV lights, not at times of their own choosing but when someone else wants to look them over . . . . When anything goes wrong, there is a rush for the seven-power glass and the microscope. Mistakes are heavily taxed . . . . But all of this . . . is as it ought to be. Because of their

very nature, much is staked on large-scale endeavors. The costs of inadequacy or failure are invariably high. And, as President Truman was wont to say, "if those concerned cannot stand the heat, they should get out of the kitchen."

The point at issue in all of the above is as simple as it is important: the space program is a politico-social phenomenon and is subject to both the requirements of the political process and the pressures of opinion within a restive society. In short, it must vie for support and must identify with diverse interests and needs within the nation and at the same time must assure the public that the funds and powers entrusted to it by the public are supportive of public purposes.

Former Administrator Webb explained the matter in down-to-earth operational terms on a variety of occasions. Thus in a staff memorandum dated March 12, 1963:

> For my testimony . . . I would like to know the latest results of our postcard poll on subcontractors. Any up-to-date information I can have in mind that permits me to talk on a more recent basis than other witnesses will help me present the image of an agency that knows what it is doing. I would like to be able to show that the fan-out to small contractors all over the country from our prime contractors is progressively taking place as the program enlarges and that we are taking steps to find out more about this.

And in a Webb report dated May 4, 1962 on a meeting with President Kennedy:

> . . . The President also expressed some concern over the reports that are coming to him from states like Michigan, Pennsylvania, and the eastern states, that the concentration of space contracts in California and the expenditures in Florida, Mississippi, and Louisiana seem to leave out capabilities that should be available for the program and tended to favor those states. He is quite anxious that we maintain the best possible geographic distribution of contracts and still get the most efficient job done with the funds expended.

And, to President Kennedy in a subsequent letter dated June 1, 1962:

> . . . As the space program continues its current acceleration, there is increasing participation by business concerns in practically all sections of the country . . . . these figures for our last completed full year do show in an encouraging fashion how widely NASA's contracts are being fanned out among the States.

A further point that requires emphasis is that NASA's feedback requirement relates not only onto the completeness and pertinence of data but also to (1) the rapidity--real time--with which data are gotten into the informational system within NASA and between NASA and its environment and (2) the skill with which the information is packaged for presentation purposes. It is obvious that the best of information if not delivered at the point of critical need is in practice very poor information. It is also obvious that if information is to serve other than information specialists it must be in terms and in forms that can be easily understood and readily transmitted and convincingly explained to others. Webb stressed this point in a staff memorandum dated February 29, 1964:

> In view of the lead article in the New York Times today about the growing concern for a better region of distribution of our program, and in view of the interest expressed in the Senate Committee in the past on requirements for scientists and engineers, I am wondering if we could not prepare a page or two of material on the distribution of our work and the utilization of scientists and engineers which I could use in the Senate to answer questions if they are asked. These two subjects are not unrelated, and I think a skillful weaving together of the great benefits to be gained by the country from the way we are handling our programs in both fields would be very worthwhile.

Initially, of course, NASA's feedback requirement as against the environment was relatively simple, since the public and its elected representatives were overwhelmingly behind the national goal of preeminence in space. Aside from the matter of getting birds to fly, public interest and concern centered almost entirely around the bare bone issue of the distribution of work--that is dollars--around the country. But as the space effort entered the long-haul phase, and particularly as the threat of unchallenged Soviet

dominance in space receded, the issue became far more complex. Increasingly, it came to involve such fundamental questions as whether the national interests of the United States required a far-reaching effort in space, whether the conquest of space would contribute in any lasting way to the advancement of our society, even whether our national pride had not caused us to embark on a highly wasteful and foolish undertaking.

Quite clearly the year 1963 brought a water shed in broad-based public support for the program (i.e., brought a breakdown of the automatic "national consensus" behind the program).

The changing situation with regard to public attitudes began with the buildup of a multifaceted campaign against the "moon goal." This campaign, it should be noted, rested upon a distorted view of the role of the moon landing. While the NASA leadership from the first repeatedly emphasized that the project was not an end in itself, but was a "focal point around which could be organized in a purposeful and coordinated way a range of activities that would collectively give us both the general and specific capabilities needed for the attainment of national preeminence," the prevailing tendency was to equate the "moon program" with the space program itself. This was in part due to President Kennedy's own early stance.

As a political leader, and one deeply concerned with improving the image of the U.S. abroad and his own Administration at home, what Kennedy most wanted in space was the promise of a U.S. success of a magnitude and importance that would--in one fell swoop, as it were--offset the advantages the USSR had gained from its exploits. Kennedy became convinced that the U.S. could beat the Soviets to a moon landing. And once this was so, he tended to subsume the drive for leadership in space to the drive to be first on the moon. Thus in defining the decision he was asking the Congress and the people to make on May 25, 1961--a decision that would in his words

"demand a major national commitment of scientific and technical manpower, materials, and facilities"--he spoke exclusively in terms of the moon landing: "I believe we should go to the moon. But I think every citizen of this country as well as members of the Congress should consider the matter carefully in making their judgment . . . because it is a heavy burden, and there is no sense in agreeing or deciding that the United States take an affirmative position in outer space unless we are prepared to do this work and bear the burden to make it successful."

It is understandable that Kennedy chose to focus on the most dramatic part of his space program and the part that could be most easily visualized and understood by the average voter. Nevertheless, the effect was to give support to other forces and circumstances that were almost automatically working toward distortion of the lunar project. The sheer drama, complexity and costliness of the moon enterprise were of a magnitude to overshadow everything else related to space. Beyond this, the news media latched onto the "moon race" idea with a singleness of purpose that excluded any real appreciation of other aspects of the space program, much less the broad needs and purposes that the moon effort was itself to serve. There came to be a more or less general equation of the space program with the moon program, and more particularly with the race to beat the USSR with the first man on the moon. And success in this race came to be equated with success in the way of achieving U.S. preeminence in space.

Initially, this over-simplified view of the relationships between the moon effort and the overall effort the United States was making in space was probably helpful in securing support for the national effort. A complex and difficult task like that of getting first to the moon was the sort of thing Americans were confident they could do; and given a feeling that doing it would put the U.S. on top once and for all, enthusiasm for going

ahead was certainly greater than would have been the case with some other approach. Many in the Congress had long been clamoring for the moon goal, and it was on this element that congressional attention centered as, first, the supplementary requests for fiscal 1962 were given quick approval, and then, some few months later, a whopping $3.67 billion was voted NASA for fiscal 1963. But over the longer term the effect of the overdramatization of the moon goal was to give an opening to a small number of dissenters who sought to discredit the whole space enterprise.

The problem was that when taken outside the context of its role in the general buildup of space capabilities and viewed as an objective in itself, the moon goal could be plausibly questioned from the standpoint of whether it was worth the cost, or indeed made a great deal of sense.

Thus not a few highly influential members of the scientific community who had advocated a "science" managed and a strictly science serving "instrumented" program were able to carry on a running campaign against the total of the U.S. effort on grounds that it was a massive but empty, prestige-seeking "moon race" that would leave the United States little better off than it was before. These argued that through undertaking the moon landing goal the United States was denying itself optimum use of space to extend scientific knowledge and understanding, ignoring in the process that for space technological advances must precede scientific advances and that everything to be done in connection with the moon project would automatically add to scientific knowledge and augment scientific capabilities. Similarly, many of those who had wanted a militarily-oriented space effort could claim that the country was putting all of its space eggs in the moon basket and at serious risk to the national security. These in their turn passed over the fact that the capabilities being developed in connection with the moon project were the very same capabilities that were necessary

both to further military needs and to insure that space could not be turned by a hostile power against the United States or any other free country. Both the scientists and the military-oriented also ignored that within the overall national effort a great deal was being done which did not relate to the moon program but was directly aimed at the development of basic scientific as well as military capabilities.

A third line of attack was that the funds the U.S. was pouring into an "empty race to the Moon" could be far better used to constructive purposes on earth. Sounding the keynote for this point of view was the powerful voice of Senator J. William Fulbright, Chairman of the Senate Committee on Foreign Relations. At Tufts University on May 3, 1963, he said that the moon project should be abandoned and the money used to help with such earthly problems as the improvement of education. He added that, "This allocation of priorities is a recipe for disaster, an unrecognized and powerful endorsement of the wrong side of the race between education and catastrophe." Two days later Fulbright said before another group that he found it "strange" that "in a world which bears an intolerable burden of hunger, disease, poverty and animosity among its people, we should devote so many of the best minds of both the western and communist worlds to achieve a landing on the moon, where, to my knowledge, no solutions to our problems await us." Then General Eisenhower threw his weight into the mounting debate. "Proud as we may be of our astronauts and our Venus probe and other accomplishments in space," he wrote in the Saturday Evening Post on May 18, "this racing to the moon, unavoidably wasting vast sums and deepening our debt, is the wrong way to go about it, as I see it." Subsequently, similar arguments came to be repeated in a variety of quarters, including an increasing number of newspapers and a highly vocal minority in the Congress.

A circumstance that added greatly to the vulnerability of the moon

project when taken out of its context as a capability-building enterprise and viewed in terms of a specific race with the USSR was that the moon goal depended for its rationale on the demonstrated will and ability of the USSR to compete in that particular race. This gave the Soviets an opening that they were quick to seize upon in an effort to contribute to confusion and uncertainty among Americans as the rationality of their space endeavors.

On August 9, 1963 a letter that Sir Bernard Lovell, Director of the Jodrell Bank Experimental Station in the United Kingdom, had written to Deputy NASA Administrator Hugh L. Dryden appeared in the U.S. and overseas press. In this letter Lovell reported that on a visit he had just completed to the Soviet Union, M.V. Keldysh, President of the Soviet Academy of Sciences, had told him that the USSR had rejected, for the time being at least, any plans for a manned lunar landing because of "insurmountable problems of radiation in space."

Excitement over this letter was immediate and intense, and while it was still mounting Khrushchev himself entered the lists. In an "Interview with Newsmen" that appeared in Izvestia on October 26, 1963, he was directly quoted as saying: "At the present time we do not plan flights of cosmonauts to the moon. I have read reports that the Americans wish to land a man on the moon by 1970. Well, let's wish them success. And we will see how they will land there, or to be more correct 'moon' there, and most important--how they will get up and come back. We will take their experience into account. We do not wish to compete in sending people to the moon without thorough preparation. It is obvious there will be no benefit from such competition. On the contrary it would do harm since it would lead to the destruction of people. It is a joke in our country to say 'who is impatient on the earth, let him go to the moon.' For us it is good enough on earth. But if we are to talk seriously we will have to work a lot and

prepare well in order to complete a successful flight of man to the moon."

These "authoritative statements" from the Soviet side were avidly seized upon by those who were opposed to the U.S. project: The USSR was being as sensible as the U.S. was foolish. What meaning could there be to winning a race in which the other side was not competing? At the cost of tens of billions the U.S. might someday get its man on the moon, but what of it? The Russians in the meanwhile would have grown much stronger in consequence of their use of resources for more practical purposes.

More important than the reaction of out and out dissidents was the impact on many who had looked upon the Kennedy program as the proper thing to do: Perhaps the U.S. had already decisively bested the Russians and it was no longer necessary to continue a large-scale effort. It might be wise to slow the pace, and even put some of the things we had planned "on ice." In any event, a harder look should be taken at the scheduled rate of expenditures with the thought of effecting maximum savings for use in connection with other urgent programs. Doubts such as these came to be rather widely reflected in editorial comment of many newspapers that had hitherto been staunch supporters of the space endeavor. Of more direct and immediate importance was a change of mood in the Congress: a Washington Post roundup of Congressional opinion on Khrushchev's statement indicated that most Congressmen felt the statement would result in at least some reduction in funds for the space program.

Meanwhile, the importance to the nation of an all-out effort to best the Russians in space was dealt a sharp blow from another side: President Kennedy quite unexpectedly incorporated this paragraph in an address before the UN General Assembly on September 20, 1963:

> Finally, in a field where the U.S. and the Soviet Union have a special capacity--in the field of space--there is room for

> new cooperation, further joint efforts in the regulation and exploration of space. I include among these possibilities a joint expedition to the moon.

The impact of the President's gesture is indicated by a letter of September 23, 1963 to Kennedy from Congressman Olin Teague, staunchest of supporters of the space program:

> On May 25, 1961, you stated to the United States Congress, "I believe this nation should commit itself to achieving the goal before this decade is out of landing a man on the moon and returning him safely to earth. No single space project in this period will be more exciting or more impressive to mankind or more important for the long-range exploration of space and none will be so difficult or expensive to accomplish."
>
> In view of your statement to the United Nations suggesting the possibility of a joint venture with the Russians to reach the moon, I am very anxious to know whether or not this national goal is being abandoned or changed.
>
> I was disappointed in the suggestion. I have been a very strong supporter of the space program believing we can be the first nation to put a man on the moon and knowing that we must achieve this goal if we are to help establish the fact that space will be used for peaceful purposes. Also, I believe that our national security and the security of the rest of the free world is very dependent upon the success of our space program.

Other strong voices were also raised in defense of the moon project, as for example Representative J. Edward Roush of Indiana on October 29, 1963:

> Mr. Speaker, the announcement that the Soviet Union is withdrawing from the race to the moon has produced some disturbing reactions here in the United States. Here we have a breakdown in the Communist system. Here we have an opportunity to exert real leadership and show what a free economy can do. And we have those who are now advocating that we abandon our efforts to explore the universe. I am perturbed. Why must we do something just because the Soviet Union does it? Why should we refuse to do something just because the Soviet Union refuses to do it?

Nevertheless, the national sense of assurance that the space program as it had been conceived and developed and as it was being conducted was clearly in the highest interests of the United States had been shaken. And as time passed not only did the cries and shouts of the dissidents mount;

questioning tended to increase among the populace generally. People became less and less concerned over the simple matter of "beating the Russians." They became increasingly concerned over how the space effort fits into the big picture: where it is leading in terms of the basic needs and objectives of our society. Dr. Abraham J. Heschel, physicist turned moralist, asked a question that many were increasingly puzzling over: "Of what value will it be to land a man on the moon if we neglect the needs of millions of men on earth?"

NASA management quickly grasped the implications of the changing national mood. It recognized that the informational needs and responsibilities of the Agency with respect to the environment would necessarily extend beyond a "score card of successes," on the one hand, and reportings on particular impacts on particular situations in particular areas, on the other. There would be greater and greater need for a picture of the broader ramifications of particular impacts, and even more important, of second and third order consequences of the space program and its attendant policies and activities for the whole of our society and its basic interests and values. The requirement, as NASA management evidently saw it, was an ability to evaluate the space program in terms other than either the values of accomplishments in space itself or the benefits deriving from a recirculation of tax revenues. As Webb explained in a staff memorandum of August 12, 1963, NASA's need was "to seek some basis from feedback that may come to us from the 'national need' area to see how our policies cover the national need. Do they cover them completely, or only in part?" The purpose would be not only to do a better and more comprehensive job of reporting but also to secure feedback of information and judgments that could be brought to bear on the conduct of programs and in the decision-making process at various management levels. Webb wrote in a staff memorandum of

October 16, 1963:

> One of the main problems. . . is to determine what additional values the space program has beyond the development of a scientific knowledge of the space environment, a knowledge of the technical requirements for the rocketry side, and the demonstration of a satellite as a prototype . . . . Further, the policies which might be applicable at this time when we have already begun a ten-year program to spend $35 billion in this field, and have already expended some $7 billion of it, may be quite different than those which should be applied at the end of this period or at the beginning of a new period. We should find some flexible means by which we can relate these decisions not to some absolute criteria, such as control of funds by mission-oriented agencies, but rather, to the total structure of our space program and its relationship to all other factors [affecting our society].

Webb made more explicit the sort of thing he had in mind in a staff memorandum of October, 1964:

> Please accumulate the data for the group of states involved in manned space flight and which center on Huntsville along the same lines as the data you have gathered for Louisiana and Alabama. I would like to include in the material on the groups of states running from Florida up through Georgia and over through Alabama, Mississippi, Louisiana, Arkansas, Texas, and also Oklahoma as much data as possible on NASA activities. This would include any economic impact data we have, any university program data, including particularly the research grants, sustaining university program and training grants, any material we have showing how the opening up of the space age is providing intellectual and economic opportunities for the youth with increasing development potential to realize these opportunities in industry, in universities, and through contacts with the government installations.
>
> As to method of presenting this data . . . perhaps we might consider a "Black Book" with this data related to the manned space effort and then a second "Black Book" related to all the other programs. I will be glad to discuss the format of the presentation of the data when you can tell me roughly what we have.
>
> NOTE: If additional data is available as to other federal programs, such as that for the Arkansas White and Red River systems, it might be worthwhile to show how our data and our technology utilization program both gain from these expenditures and can make a contribution to the net value of these expenditures to this region.

Webb also emphasized the need for adjusting informational products as the NASA program progressed. In a staff memorandum of September 11, 1963:

Attached hereto are all the papers I have on the shortage of engineers and the requirements for the NASA program. Please have someone, either from this material or more recent material, put together in the simplest form reference material that I should keep available to handle inquiries and meet any issues which come up. Obviously, the issues I will be dealing with are different now than they were when this material was gotten together for the hearings on the Authorization Bill. This is partly due to the changing ratios and partly due to the reductions in the program. Also, if someone on your staff is to be the central point of contact and reference in this matter, he could keep up the material by arrangement with Colonel Young.

Enclosures:

1. Draft, summary report (appendix) 5/2/63 "Analysis of the requirements for and recruitment of scientists and engineers
2. Memo for Record 8/26/63 written by SP Young re: Dr. Killian's request for asst. fm. Dr. A. Gamble
3. Cy. of article "The Engineer Shortage" by W. Douglas
4. Grad. Training in Engineering, Math., and Phy. Sci. (President's Science Advisory Committee)
5. Analysis of Univ. Manpower used on NASA Programs - Present Status (Dr. Smull, 7/24/63)
6. Study - Scientists, Engineers Requirements Study
7. Manpower Report of the President and a Report on Manpower Requirements, Resources, Utilization & Training (Submitted to Congress March 1963)
8. Booklet - Civil Service Inventors (Reprinted from Civil Service Journal)
9. Vol. 3, No. 4 Civil Service Journal Article "Scientific Manpower: Progress & Prospects"
10. Copy of Memo to Mr. Young fm. Mr. Lacklen 4/10/63

Some time later NASA's top command set in motion a process that it hoped would greatly strengthen the Agency's ability to cope effectively with the increasingly complex feedback requirements that were being raised by the rapidly changing external attitudes. The nature and underlying rationale of this move were spelled out in a memorandum dated January 26, 1965 from Webb to Associate Deputy Administrator George Simpson. This

document, it seems to us, admirably sums up both the conceptual approach and actual operational requirements for an effective NASA information system as against the environment. We consequently quote it at some length:

> In accordance with the agreements that Dr. Dryden, Dr. Seamans and I have reached with the Chairman of the Atomic Energy Commission, Mr. Finger will be for the next period, perhaps as long as three months, on detached duty from his major area of responsibility . . . .
>
> In his new assignment, Mr. Finger will have the additional duty . . . of Special Assistant to the Administrator . . . . his responsibility will be to serve with you and me as a group of working task force leaders to mobilize the resources that are now set up in various parts of NASA to express more clearly than we have in the past our policies, and the actions we have taken to implement these policies, in terms that can: (1) provide a basis for proper reporting to the President and the control coordinating agencies such as the Bureau of the Budget, the Office of Science and Technology, the Space Council, and others; (2) identify and inventory the requirements for public statements, speeches, and other expositions of NASA policy and programs to be made by the senior officials of this agency and make sure that this material and these occasions are handled so as to clearly and unambiguously state what we are about, how we go about it, and the relationships we have with our contractors, with our sister agencies in the Federal Government, with universities, and with such units as the scientific community, the technical engineering community, the commercial and trade process, etc., and (3) arrange the materials which emerge from the above process so that they can provide a guide to the thinking and expressions and the understandings of our senior NASA officials and at the same time give them an opportunity to help us incrementally improve this work.
>
> . . . since 1961 NASA has built on a vast base of experience gained in NASA since 1915, in our military services during World War II and since, and in the scientific and technical areas of our Nation. I believe we have proved that we can make our birds fly, design and send out instruments that will send back and receive information needed by scientists and by engineers, and create a structure under which the Government can insure a proper planning and execution of a very large program involving many parts and components, and do this within the structure and strengths of our economic, social, and political system. However, as NASA emerges from the period of rapid growth and these accomplishments, we must constantly refine our organization and our thinking about our problems and our method of attacking them and not let the central coherence and drive which came from the requirements of the buildup period fritter away in the topping out period. . . .

One of the most important areas facing us is the development of a pattern of working relationships with the other entities in our Federal structure. This includes the legislative as well as the executive. Whether we like it or not we have become a strong agency, in fact one of the predominant agencies, in science and technology in the Nation, and in the world. As Dr. Bisplinghoff has so well stated it, we have perhaps the most able technical group anywhere in existence, but we have not perfected the means for focusing the capabilities we have on the most important problems in such a way as to get the best solutions for many problems which run beyond the jurisdiction of this agency.

I think it is more clearly recognized than in the past that if Congress had wanted NASA to proceed only in accordance with the limitations of vision and understanding of the development process which is available in other agencies, it would never have created NASA. We were created to add something new and we must find a way to do that, working closely with others in the process, so that the whole governmental structure develops in a viable and proper manner. One of the more important jobs for you, Finger and me, as the working leaders of the groups over which we take functional supervision, must be to develop this kind of concept into something that can be read, marked and inwardly digested by both the present leaders and those who are emerging in NASA.

II Performance Against the Concept and the Requirement

The foregoing brings into sharp focus the critical question as to whether NASA's methods and procedures for obtaining and analyzing data on the impact of its programs and activities, and for reporting on these impacts to the Congress and to the public, have in practice been adequate to the changing and expanding needs of recent years. Even more critical is the question of whether they will be adequate to the requirements of the future when the nation will face difficult choices as to priorities among many competing demands and when there will be lacking the focal impetus that went with the moon landing project. Can NASA, in other words, rely upon existing methods and procedures and expect to secure the sustained support it must have if we are to continue with a viable space program? If not, what needs to be done?

The matter, as we see it, revolves around the ability of NASA to justify a national recommitment to space. As we wrote for the lead article in the 1969 Winter issue of Orbis, A Quarterly Journal of World Affairs:

> The issue . . . is not the simple one of whether the United States is to press forward with a major space effort after completion of the Apollo moon landing project. Neither is it whether some dramatic postlunar goal is to be set, or new and imaginative missions undertaken to advance scientific knowledge or increase military capabilities, nor even whether we are to make an all-out effort to commit our space capabilities to the betterment of life on earth. These are matters of importance . . . . But the basic issue is whether the United States is to carry forward on a sustained basis the balanced program of space activities which alone can lead to preeminence.

We further amplified the same point for a special issue (September, 1969) of the Bulletin of the Atomic Scientists:

> Even as euphoria continues to sweep this country in the wake of the successful moon landing, and even as the world remains in awe of the magnificence of this achievement of American courage, science, technology and organization, the United States is in danger of slipping into a position of enduring inferiority as a spacefaring nation. Some discerning wag once said of the Southern Confederacy that its epitaph should read, "Born of States Rights, Died of States Rights." Is it possible that a variant of this will come to be applied to the U.S. commitment to preeminence in space: "Born with the Moon Goal, Died with the Moon Goal?" In calling attention to this paradoxical possibility . . . , my thought relates . . . to the deterioration of national purposefulness with respect to space that has increasingly marked . . . our society as we have progressed toward realization of the moon goal, and even as we now stand at the pinnacle of success.

NASA has taken two main approaches in its efforts to determine and report on the socioeconomic consequences of its program and activities:

1. It has developed in-house informational systems designed to obtain and to provide effective reportage, on both a regular and spot basis, data as to the direct and immediate impacts of its programs and activities; that is impacts, largely in statistical terms, from the standpoint of geographical distribution of funds, and effects on local employment and manpower situation, national resources in the way of scientific and technologically trained personnel, small business interests, etc.

2. It has funded outside studies of broader ranging and longer term impacts and consequences, including secondary and tertiary as well as primary.

Of the many informational systems within NASA, two were set up especially to meet environmental feedback needs. One of these is the system for collecting and analyzing information on NASA subcontracts (the "Postcard System"); the second is the joint NASA/DOD Joint Economic Information System.

The NASA Subcontract System was developed to collect and present information on first tier subcontractors greater than $10,000 which are from

NASA prime contracts greater than $500,000 and on all second tier subcontracts greater than $10,000 which are from first tier subcontracts greater than $50,000. The system is now in its seventh year of operation, and it appears to us quite evident that it has served very well a number of important requirements of NASA management:

(a) It has provided management with feedback on a real-time basis regarding performance against certain basic NASA policies, including policies to the effect:

> . . . That NASA expenditures in the non-governmental sector, which account for over ninety percent of funds appropriated to the agency, not be concentrated on a few main suppliers of goods and services but be dispersed over as wide a range as consistent with high quality standards;
>
> . . . That where technically feasible NASA procurement extend to geographical areas outside those of major industrial and technological concentration;
>
> . . . That contractors and/or subcontractors make positive efforts to share NASA generated work with small businesses;
>
> . . . That to the extent technically feasible, NASA-generated work support government objectives with regard to surplus labor areas;
>
> . . . That NASA procurement not be so concentrated either geographically or by contractors as to entail a drain on highly trained and skilled manpower but be handled in such a way as not only to replenish but to build-up such manpower resources.

(b) The system has at the same time enabled NASA management to discharge its responsibility to keep the Congress and the public informed on both a regular and a spot inquiry basis as to major aspects of the impact

of NASA procurement activities. It thus has furnished an important link in the feedback system operating between NASA and its environment.

The NASA-DOD Joint Economic System collects information on employment and cost at the plant sites of major NASA contractors. This information in turn is used to make the estimates of total employment on the NASA program. Establishment of the system was in direct response to criticism voiced in the first half of 1963 to the effect that the NASA program was detrimental to the growth of the nation in that it was siphoning off the limited supply of scientists and engineers. James R. Killian, President of MIT, set the tone for this criticism in the Atlantic Monthly of March, 1963:

> . . . If our vast research and development effort in defense and space works [should] even for the short term curtail productivity and economic growth in the United States, the results will damage not only the civilian sector but the space and military sectors as well; our national goals of all kinds, and certainly our defense, depend upon rising productivity and upon our maintaining a sound rate of economic growth. Both depend in part upon the inventiveness and initiative of the civilian sector of our economy and upon an adequate effort in uncommitted basic research, in contrast with applied research and development. While I doubt whether we yet know very much about how economic forces are affected by the distribution of effort between civilian-commercial research and development on the one hand and military space research on the other, we do hear, increasingly, concern expressed that the growing military and space research programs may be retarding innovation in consumer products and shortchanging that consumer sector of our economy.
>
> This is why some of us feel that we cannot charge ahead with additional space and other large technological government programs without being mindful of the possible adverse effects on our civilian economy and of the importance of weighing them along with the good effects. I note this in full recognition of the economic assistance our expanding space program is providing many industries and communities.

NASA's initial response was an internal document, "Analysis of the requirements for and recruitment of S&E"s [scientists and engineers]," by Dr. A. Gamble. Dr. Seamans used Dr. Gamble's estimates as the basis of a personally signed rebuttal article that was published in the Washington Sunday

Star on May 25, 1963:

> At the beginning of the year, something like 3 to 4 percent of the scientists and engineers required by this country were being used in the space program. This proportion will grow to 6 to 7 percent by the beginning of next year, and may get slightly higher as we continue through the decade. Although this represents a significant proportion, it does not approach the figures used by those who say we are taking much larger numbers. Moreover, through our graduate training program with American colleges and universities, we are augmenting the national capability and pool of scientists and engineers.

NASA, however, decided not to rest with this one-time reaction but to stay on top of the issues involved as well as any others of a similar nature that might come up in the future. This decision was reflected in a staff memorandum from the Administrator of September 11, 1963:

> Attached hereto are all the papers I have on the shortage of engineers and the requirements for the NASA program. Please have someone, either from this material or more recent material, put together in the simplest form reference material that I should keep available to handle inquiries and meet issues which come up. Obviously, the issues I will be dealing with are different now than they were when this material was gotten together for the hearings on the Authorization Bill.

The Joint Economic Information System (EIS) was initiated to meet this requirement. The evolution of the EIS as an internal mechanism began in the spring of 1964, when the Form 1086, "NASA Contractor Employment Report," was developed to obtain NASA contractor employment and related costs incurred data to be used as a basis for estimating the impact of NASA programs upon national manpower resources (particularly scientific and engineering manpower) and upon individual communities and geographic areas of the country. The Contractor Employment Report was resorted to after several attempts to obtain the required data from existing systems had proved abortive. The first data collection was undertaken on a pilot basis for the six month period ending June 30, 1964 and included approximately 120 contractor plants.

The Contractor Employment Report following its pilot run was expanded at the request of the Bureau of the Budget to cover the Department of Defense

data, and was redesignated "The Joint Economic Information System." The first report under the joint system was for the six month period ending December 31, 1965 and covered approximately 250 plants. The system has since been expanded until it now covers approximately 400 plants and plant complexes, of which NASA has business in approximately 260.

NASA further cooperated with DOD by providing DOD with forecasts of NASA manpower requirements in each plant where DOD had significant activity. This was in support of a special continuing analysis of employment impact that the Department of Defense was undertaking for its major contractors. This DOD effort, we understand, was "lost" in consequence of the more pressing problem of Viet Nam and has not been updated for the last year and a half.

The data collected by the EIS have served as the principal basis for preparation of the NASA "Manpower Information Digest"; for estimates and projections of the employment impact of NASA programs upon individual plants, communities and geographic areas throughout the nation; for preparing replies to Congressional requests for anticipated employment changes by State or Congressional District; and inhouse for estimating the manpower requirements of new proposed programs such as Voyager.

More important, however, than a list of what has been done is the fact that the system has been the basis for an ability of NASA to make on an on-line virtually real-time response to queries concerning contractor manpower. In this respect it has contributed to build-up of a NASA image as that of an agency that knows what it is doing. The estimates of NASA manpower utilization, both actual and anticipated, became a crucial part of the basic information provided to the public on the space program. As a matter of fact there have been few speeches made by the NASA Administrator where one product or another from the EIS system has not been used. It is interesting

to note that the DOD has not made its available information on the impact of DOD programs available to the public on anywhere near as extensive a scale as has NASA.

In general, NASA has achieved a good record in staying on top of, and reporting effectively on, developments in the area of its direct impacts on the environment. One example will illustrate what we believe to be a fairly general situation. The Administrator reported in a staff memorandum of March 18, 1966:

> I have just talked to Commissioner Okum of the Council of Economic Advisers who is serving as acting chairman, and he wanted to inquire about an article in the Wall Street Journal saying that 40,000 people would be out of our program by the end of Fiscal Year '67 under the budget. I told him we had done a real job to try to find out what the effect of the budget would be and that our first preliminary figures showed that the loss would not be 40,000 but about 82,000, and I pointed out to him that a good deal of the testimony relating to the 40,000 was related to the expenditure estimate in the budget which seemed to us not completely realistic. I pointed out that we had given testimony in answer to questions up in Congress about this.
>
> I also informed him that we were doing a good deal of work to try to clarify our understanding of the employment picture with respect to 1967 and would have more information later.
>
> It turned out that his inquiry was not to express concern about the drop in employment, but rather to say that this was a healthy sign in terms of the total national picture because it would operate to offset increasing employment in other areas like defense. At the end, I invited him to come over and see our system for accumulating these pictures. He said he would like to do so and said that he had found no other place in the government that has as good information as I seemed to have readily available to give him. I think we should invite him over as soon as we get to the next point of clarifying our statistics.

The Agency, however, has had less reason for satisfaction over performance with regard to the broader socioeconomic impacts of the space program, and particularly for second and third order consequences. For the most part NASA has relied upon universities and profit and non-profit research organizations and groups for studies and evaluations of these broader aspects of its inter-relationship with the environment. Although the scale of

NASA's efforts along these lines have been large in comparison with what other public agencies have done in the area, the results have so far fallen far short of what NASA has evidently been seeking. Most of the products have contributed in one way or another to a better understanding of some aspect or another of the space program. But few, if any, have been responsive to NASA's needs and purposes as described above. Many simply lack relevance to the specific questions about which NASA is most concerned. In many instances, they appear to be representative more of the personal priorities of the investigator.

In the case of the better and more valuable, the products suffered from a lack of attention to the second and third order effects of NASA programs. In other words, too narrow a view was taken as to the analytical potential of the data available, as well as with regard to the nature and range of NASA management's interests and needs, and particularly in relation to ongoing operations. We believe that with broadened sights and with different and more sophisticated analytical approaches and methods much more useful results could have been achieved.

Research in most instances was limited to direct economic impact only; and often quite limited economic impact at that.

Another serious fault has been a tendency on the part of the investigators to fight the data in one way or another. One form of this was to concentrate on the processes that NASA uses to collect data and then to argue for basic revisions in the system. An example is a study done by Jack Faucett Associates:

> Since all the data are taken from final contracts, they are believed to be quite accurate. The principal deficiency in these individual prime contract action reports for economic analysis is that in some cases the place of performance shown on NASA Form 507 may be interpreted to mean that all the contract amount is to be performed there, while in fact much of the work is often performed in other plants of the contractor or is subcontracted

> to a large number of outside firms located over a wide geographic area. In addition, there is need to tabulate these data by Standard Industrial Classification (SIC) establishment and product codes to facilitate their comparison with census industry and product statistics.
>
> It is recommended therefore that NASA should consider modifying Form 507 to (1) require contractors to indicate the share of the contract (including modification) which is to be performed at each location of the prime contractor's own facilities, (2) require contractor to indicate the SIC code for each establishment, and (3) to make provision for SIC product coding by the NASA Headquarters Office of Procurement.
>
> The existing reporting systems in NASA in most cases were designed to meet the technical and administrative needs of the NASA organization without specific consideration of the needs for socioeconomic analysis. Those reports, designed to provide information on the impact of NASA's program to Congress, the Chief Executive, and the public, have been developed largely in response to specific types of requests and without the guidance of a comprehensive and integrated program. Further, only a minimum consideration has been given to the information requirements for the introduction of the economic analytical function into the internal policy and management decision processes. As a consequence, the maximum use of existing data collections has not been realized and important gaps exist in the information which is consolidated and reported from these data collections. There is an obvious necessity for these reporting systems to be further evaluated from the standpoint of satisfying multiple needs, including the economic analysis requirements as well as the needs now being served.

The product NASA had contracted for in this instance was the development of a procedure and a methodology whereby information systems available in NASA could be more effectively used to get a better understanding of matters of immediate relevance to NASA operations and policy making processes, not counterproductive recommendations that would shift the focus of the information systems to the service of research objectives only distantly related to ongoing NASA needs. If such recommendations were to be implemented, the effectiveness of existing information systems would be reduced from the standpoint of ongoing management needs and would be to interfere with the much-needed real-time flow of information. The point here is that an information system as a management device must furnish information as to

what is going on when it is going on in order to permit evaluations of performance against policies while performance is actually under way, and to enable needed on-course corrections. An information system might serve other purposes at the same time it furnishes real-time feedback to management, but it must not be diverted to these other purposes. The systems in question are the important link in the feedback system operating between NASA and the environment, and in this respect are fulfilling a prime purpose.

Another criticism that we feel appropriate is that many of the studies have been "data heavy," while lacking in interpretative analysis needed for understanding the real impact of the space program. The point is that inference rather than an aggregation of numbers is needed by NASA.

To state our point again: NASA is a political entity; it depends on public support. Aggregations of numbers are not nearly as meaningful as are inferences. Webb emphasized this point in a staff memorandum of September 13, 1963:

> My purpose is not to show the amount of dollars going into R&D by states, but rather to get some picture of how the very advanced areas of technology which are coming out of our program are providing small nuclei or seed beds for such advanced technological work. . . . If we would show that through our contracts and subcontracts a certain substantial amount of advanced technical work is being broadly disbursed throughout the country, I believe we could draw the inference that this is providing a powerful influence for more efficient utilization of technology, which will be increasingly felt over the years ahead. Also, it is one of the best guarantees that those areas will get in a position to compete for R&D work as prime contractors. Why don't you see what you can do on the basis, not of complete dollar figures, but rather on the basis of where our sub-contracts do support vigorous, aggressive, very advanced groups, and then consider . . . whether it is possible to study how some of these groups may be affecting the states and regions within which they are located.

Also, the studies generally have been unduly oriented toward "depression economics": how many jobs have been created, how much income generated, how serious would be this size cut in funds, etc. NASA's need is for

more than answers to the usual Keynesian questions. Mr. Webb put it this way in a staff memorandum of October 21, 1963:

> Please draft an agenda item . . . and initiate staff studies . . . along the lines of showing not only the dollar volume of contracts and subcontracts that go into the various states, but the value of having, in a state like Wisconsin, [a contractor] group doing the Apollo guidance and control. I believe we will find in almost every state an advanced group in some specialized area which offers the promise to that state of being in the forefront of technological advances. If the state would recognize this value as much as the payroll value of NASA contracts, there would be a better understanding of our focal point position in encouraging local efforts to use advanced technology.

Most of the studies have suffered from "over professionalization." They have tended to rely on the methodology of a single discipline to the exclusion of others. They have all too often treated the inquiry being pursued as an end in itself, rather than as part of a larger inquiry looking toward development of a total picture. And results of findings have been presented in terms and forms that make them understandable and useful only to the specialist, and not in terms and forms that can be easily understood and readily transmitted and convincingly explained to all of those within NASA and on the outside who need to know.

Also, it should in all frankness be said, the studies are frequently incompetently done. It might be well here to cite some of the findings of Ida R. Hoos of the University of California at Berkeley regarding attempts to apply systems analysis techniques to social problems and situations. With particular reference to the work of "research firms," but not without relevance to other research undertakings, including those within universities, Hoos argues that: The methodology is overdone. Frequently the relation of the "technical" portion of the result to the task at hand is not made explicit, and there is ground for reasonable doubt as to its relevance or necessity. Often fancy methodological techniques are used as window

dressing to disguise a poor or superficial analysis. In the final analysis all this results in uneasy feelings of mission unaccomplished, covered up by naming the product a "first cut" or "rough approximation."

As for the research personnel involved, Hoos sees them as "pickups" rather than trained specialists selected on the basis of outstanding qualifications, either with respect to standard research tasks or the new fields under exploration. Titles blossom, depending on the subject to be studied. In a five-man team, for example, there might be a project leader, and the others would find themselves designated "chief of socioeconomic studies," "demography specialist,"--in areas with which the extent of their knowledge was derived from an understanding of "in words," and "in theories," and particularly with regard to informational systems.

The difference between appropriately-assigned people and the "pickup" crew, Hoos argues, show in their respective approaches to the subject matter and in their attitudes toward and relationship with the professionals in any given field. Apparently assuming that there are ready-made solutions to fit neatly, albeit loosely, over any assortment of social problems, the information technicians mistake their own ignorance for objectivity, and never know when they are retreading worn ruts and rehashing disproven hypotheses. Conclusions tend to emerge in the form of naive cliches and mantic generalizations, cloaked in systems jargon to convey an impression of precision and conceptual validity. Many recommendations and predictions turn out to be commonplace or common sense, derived from lay preconceptions about the problems, and neither drawn from nor substantiated by the analysis performed.

III A Suggested New Approach

We believe that for the type of information needed by NASA for the purposes here being considered the most fruitful procedure would be to use for particular local areas the hard data that is available on NASA contracts and subcontracts in parallel with hard and soft data available from other sources and bearing upon a range of social, demographic, culture, and educational--as well as economic--trends and developments. In other words we feel that worthwhile results can be best achieved through analyzing NASA data within the framework of the data that is ordinarily used to secure a "community profile," and vice versa. After that, the situation for a number of particular local areas could be brought together to get a more generalized picture for a larger area, such as a state, and even for the nation as a whole. It seems to us that this is the sort of thing Webb had in mind when he wrote on September 18, 1965:

> The thought has occurred to me that . . . [NASA] could examine as much as possible samples of the data that show what our 20,000 prime and subcontractors are doing in terms of technology, the relationship of this to the economic progress of the states where they are located, the broadening of the base of our technological know-how throughout the country as a result of NASA work, and any other items of information that would permit us to consider and form a judgment as to what we have accomplished and how we can be guided by our experience over the past few years in making decisions as to the future.

Studies, in other words, should be of a nature to enable NASA to pinpoint and report on the influence that its policies and practices have exerted on the strengthening of the nation and particularly with regard to (1) stimulating the development of new capabilities of particular contractors

(or grantees) to do work involving advanced technology, and (2) fostering the build-up of technological resources in communities and regions which previously were, in relative terms, technologically backward (i.e., build-up in terms of new technologically oriented businesses, increase in level of highly trained and skilled manpower, and expanded competence of higher educational institutions for training and research in fields involving advanced technology, including increase in faculty resources, interdisciplinary programs, improved facilities, etc.)

The product that should be available for management to use would be not a statistical compendium but a statistically based interpretive analysis built up systematically for each of a series of representative areas. The purpose of these analyses would be to give insight into the key socioeconomic characteristics of these areas showing the impact of space activities on these characteristics. The particular question that the analyses would bear on is what the space program means to the community from the standpoint of first, second and third order effects unique for the program. The analyses would need to be custom tailored to an area and accomplished individually in the manner of a case study. Generalizations as to the impacts for larger units and ultimately for the nation as a whole would then be inferred from individual observations.

A. A Model Against the Requirement

As a means of both illustrating and testing the type of analysis we believe best meets NASA's need, we are briefly summarizing the findings from a broad socioeconomic impact of space activities on the Miami-Dade County area of Florida. We selected this area because: (1) it has not been totally impacted by NASA activity as has been, for example, Brevard County. In

fact, it has received directly relatively small amounts of NASA funds; (2) it is the economic, financial, cultural, and educational center of South Florida, a region which as a whole has received substantial NASA funds; (3) it is an area in which there has long been both a need and a drive for a change in developmental direction; (4) statistical and other data are available that make possible meaningful analysis in other than narrow economic terms; and (5) an analysis for this area will be of value in itself, since it is one of the dozen or so metropolitan areas of the country on which attention is currently being heavily focused and where a number of important pilot projects and studies are being carried out. Among these are: an "Economic and Engineering Feasibility Report on Planned Industrial Districts in the City of Miami," and a Food Distribution Program study, both recently completed under the sponsorship of the Economic Development Administration; a study of the Miami labor force, nearing completion under the sponsorship of the EDA; and a Model Cities program study under the sponsorship of the Department of Housing and Urban Development.

Previously NASA-sponsored research on the impact of the space program on Florida has been for the most part restricted to the area of Cape Kennedy, that is, Brevard County. These studies have been subject to the limitations noted above: They have concentrated on jobs and payrolls; they have been strongly oriented toward depression economics; they have been descriptive, given to statistical tabulations, rather than analytical and interpretive; they have largely bypassed second and third order effects. In sum, the studies are oversimplified in approach and hence do not get at many of the fundamental issues that must be examined for a like understanding of the significance of the space program in the context of contemporary conditions.

Two Brevard County studies well illustrate the lack of relevancy to contemporary conditions, as the following selections show.

In studying the Cape Kennedy area, an in-house NASA study came up with findings such as these:

> Brevard County, Florida: The announcement of a contraction of employment followed by the outmigration of Apollo employees from the county, will bring a halt to the economic growth of Brevard County. By 1971, the phase-out of the Manned Space Flight Program could result in a direct decrease in employment of about 21,800 civil servants and employees of NASA contractors. Following the primary decline in direct MSF employment, a severe readjustment can be expected in other sectors of the economy. A contraction in indirect employment of about 26,600 can be anticipated in contract construction; trade; finance; real estate; insurance; and other service industries. The decrease in primary and secondary employment could result in a total reduction in employment of about 48,000, a 50 percent decrease from the 1966 level. Because of insufficient job opportunities in the county, an outward migration of about 102,100 can be expected, leaving a total population in Brevard County of about 122,400 in 1971. This would amount to a 45 percent decrease in population between 1966 and 1971. An estimated 35,000 to 40,000 surplus housing units would be put on the local real estate market. The school population in Brevard County is likely to drop by about 27,700 between 1966 and 1971, resulting in approximately 654 idle classrooms.

The Stanford Research Institute, in a study made under a NASA contract, looked in much the same way at the reverse side of the coin:

> Brevard County experienced, from 1950-1960, one of the highest growth rates of any area in the country. This explosive growth came to an area characterized as agricultural, like most of the other areas of the South where NASA located. Furthermore, with the exception of the Air Force's Patrick Air Force Base, the area was typical of many if not all of the beach communities along the Florida coast--quiet and conservative.
>
> With the advent of NASA, of course, much of this atmosphere changed. "Satellite Motels," night life, traffic congestion, and all the other trappings of a boom town appeared. Despite such outward displays, however, communities in the immediate vicinity welcomed the arrival of space activities somewhat to varying degrees . . . .
>
> From discussions with representatives of NASA at Kennedy Space Center and persons in the local area, it appears quite clearly that these kinds of problems (and many others documented more fully elsewhere) have contributed to an inability of the Cape Kennedy area to establish long-term plans for growth similar to those in Huntsville. Although many of the same elements exist, such as higher per capita incomes, more and better

> schools, physical facilities for serving the much expanded population, and a spirited, space-oriented atmosphere, not as much of the substantive indications of change reported in Huntsville were found to exist at Cape Kennedy.

To reiterate our position: such findings represent little more than a belaboring of the obvious and are unresponsive to the really important questions. It would be absurd to think that large-scale Federal activities could be imposed on a rural area and not result in large-scale demographic and economic change in the area, or to think that the area would not have difficulty accommodating to the changes, much less working out a finely honed plan to deal with them. (In connection with this last point, no cognizance was taken in the second study cited above of the fact that Huntsville's development as a major space center extended back into the fifties and represented a graduated process and hence contrasted sharply with the situation in Brevard County, Florida.) It would also be absurd to think that a substantial reduction in the Federal activities that had led to boon conditions can take place without severe repercussions.

On the following pages we summarize the not-so-obvious impacts, which we observed in the course of our larger study and feel are definitely significant in the context of contemporary conditions.

B. A Pilot Analysis for the Miami-Dade County Area

1. Background

Our intention in this analysis is to show that the space program has interacted positively with the primary requirements of the community, and to show by inferential analysis the ramifications of the interaction of the program on the total development of the community.

The methodology is to determine the major developmental trends and

needs, or "developmental characteristics," of the area in juxtaposition to NASA activities, to identify and analyze interactions, and then to infer the nature and extent of the NASA impact.

In the paragraphs following an attempt will be made to describe the most obvious Miami problem and impute an impact of the NASA program with respect to that problem.

The Miami-Dade County pattern of development has been largely determined by location of the area in the extreme southeast of the United States and in close proximation to the Gulf Stream. This area is rich in water resources and in all the amenities of a subtropical climate, but the high cost of bulk transportation makes it economically remote from raw materials and the markets of other big cities, leaving Miami with an extremely narrow economic base, and hence heavily dependent on tourism and those things closely identified with it. The extent of dependence on tourism is demonstrated by the fact that in 1967 more than four million tourists visited Miami.

The critical ramification of this narrow economic base is that the general wage level is low and that higher-level, more professional jobs are relatively unavailable. Needless to say, the impact of this is felt most strongly by black citizens, but is in no sense restricted to them alone. The extension of this lack of opportunity is that greater proportion of members of the Miami work force are in sharp competition with one another which in turn compounds social interaction and hostilities, first between the substantial ethnic groups in the Miami area, and second within the groups themselves.

It is particularly in this latter sense that this Miami problem is in reality a "dooms day" machine of the community's own making. The civil disruptions the nation is currently undergoing are sufficient, if they should become strongly identified with the Miami area, to destroy Miami as

an economic entity. The point here is that people just do not visit places where they do not feel safe. This puts Miami in a most vulnerable position, simply because it hasn't much to fall back on should the tourists be driven away.

Let us note at this point that our objective is not to overemphasize group interactions. The general question is much more complicated than this. As we have found in the course of a study we did on psycho-social dynamics in Miami for the Department of Housing and Urban Development this past summer: Before Blacks in Miami can utilize their full potential certain local factors impairing their progress must be taken into account. First is the great lack of information and communication in the Negro ghettos of Miami regarding the existence of the various poverty-employment agencies. This phenomenon may reflect a locally inadequate public welfare communications system and perhaps an inadequate or uninformed local Black leadership. Second, and really serious, is the inadequacy of public transportation at the disposal of the Miami Black. It was evident that the substantial remedy of the problem of Black unemployment and underemployment involves a number of measures, including opening of new employment categories to Blacks, equal opportunity in all employment, development of skills and education qualifications, and better communication of employment assistance programs. But development of transportation capabilities to permit those of modest means and economic circumstances to move from residence to jobs seems to be an institutional bottleneck. The metropolitan transportation system, though public, is run on the basis of economic viability rather than on the basis of community need, as is also the case with the public road net.

Our feeling is that a beginning of a means of expanding economic opportunity in Miami would be the development of a core of higher technology

firms. The development of such firms would be a way out of Miami's "resource poor" situation. The primary product of higher technology firms of the type to which we refer is a capacity to achieve a technical result. These firms are professionally oriented. They rely on the skills of individuals, and the training, education, and experience which these individuals possess are the most important bases for an industrial work force. When industry becomes a significant factor in the area, a new industrial mix would afford the opportunity for higher income and greater opportunity and advancement for the area as a whole. What we are speaking of here is not something that necessarily benefits a presently constituted work force but rather is a longer-lead consequence that must be predicated on a change in the basic character of the area.

We feel that if it can be demonstrated that high technology industry has been developing in Miami as a consequence of the NASA program, then we do indeed have indication of broad-ranging impacts.

2. NASA's Contribution to the Development of Miami as a Higher Technology Center

To establish the possibility of this interaction between NASA and Miami, we have closely examined NASA information systems containing information that bear on the question of NASA's direct role in Miami. (Specifically, the systems examined were (1) the Status of Contracts and Grants, (2) the postcard system, and, (3) the Economic Information System.) It should be noted that this analysis bears on a unique and direct effect of NASA procurement on the Miami area. Beyond the scope of our effort is the question of spin-off from the total NASA program on technology as it affects production generally--that is, as regards new products, new uses for old products, or new methods of production. Also beyond this study is a

consideration of the possibility that the area directly or indirectly has gained a technological advantage because NASA has provided a basis for innovation on the frontier of technology in the production of either a good or service, as for example in the area of communication.

Based on the data available from NASA information systems, our first observation with respect to NASA's involvement in Miami is that from the standpoint of volume of NASA's expenditures the involvement has not been impressive. Looking at the numbers involved, we see that Dade County as a whole showed 25 contractors holding 90 prime or subcontracts with a total value over the past ten years of somewhat over 8.3 million dollars.

In addition to this reported activity in the Miami area, the testing of the 260-inch solid fuel engine at the Aerojet General plant which occupies 64,000 acres of land in Dade County involved expenditures of about 23 million dollars, raising the total or direct expenditures in the area to some $32 million dollars.

Small as this figure is, it is quite clear that disproportionate qualitative results have been produced.

The first observation in this respect is that the NASA program has been beneficial to the Miami area in making it possible for the University of Miami to attempt things that were previously out of reach and thereby has helped to increase its strength as an institution of higher learning. In all, the University has received 18 identifiable grants and contracts, amounting to a total of better than 3.2 million dollars. Specifically, the NASA grants and contracts have enabled the University to broaden its involvement in international affairs, physics, engineering, and chemistry. In a general sense their most important role was in giving balance to a research program previously dominated by the Medical School and the Institute for Marine Sciences.

From the standpoint of an area, a strong University benefits a community in a number of ways. First, it is a source of technical support for companies operating in the area. Second, it provides a vehicle to upgrade the labor force by training new professionals or retraining old ones; third, it helps directly in meeting community needs through providing a number of high technology services; fourth, a broad-base university makes the area more desirable from the standpoint of incoming industrial establishments.

The second observation with respect to NASA procurements in Miami is that they are conducive to the development of a base of technically oriented industry. The fact that the 8.3 million dollars NASA has spent in Miami, over and above the solid fuel test expenditures, have been distributed to 25 firms through 90 different prime or subcontracts indicates a reasonably good dispersion of NASA procurement that minimizes the dependency of area industry on the fortunes of any one contract of any one firm. In addition, the fact that a number of firms are active, as against just one or two, means that the total industry benefits from the operation of a number of different management teams in the area. This decentralization of the decision-making process makes industry as a whole more viable in the face of uncertainty. The opposite situation, where one contract or one company dominates, would be detrimental to any area. However, the fact that procurements do tend toward the same discipline tends to reinforce the benefits obtained from the broad-based procurement mentioned above. Specialization prevents the technical base from being spread too thin and can provide the basis for the further development of a marketable technical competence which may become the basis for further expansion. The fact that many firms participate enhances the opportunity for additional firms to develop through spin-offs. Let it not be misinterpreted that we are setting a narrow area of technical competence as a suitable final goal for any given area. Our feeling is that

the most logical and strongest growth pattern is for an area of competence rather limited in scope to become very strong, and for other areas to spin off from this first area and in turn become strong.

Helpful as have been the quantitatively limited but qualitatively significant NASA expenditures, the main impact of the NASA program on Miami has been by the back door, as it were. Specifically, it comes through extensive NASA activity in the adjacent counties of Broward and Palm Beach and through the ramifying effects of the high level of NASA activity in the state as a whole.

Within adjacent Broward County we have identified 21 companies having about 174 prime and subcontracts with awards totalling approximately 17 million dollars. Within neighboring Palm Beach County, we have identified 31 companies having about 123 prime and subcontracts with awards totalling almost 175 million dollars, most of which is in prime contract awards to United Aircraft in West Palm Beach.

By and large, these contracts have importance to the area in which they are being performed, but from the standpoint of Miami, they are complementary activities, highly additive and mutually interactive with the developing higher technology industry in Miami. However, the principal point with respect to the Miami problem is that these contracts have brought to the proximity of the Miami labor market substantial numbers of trained personnel capable of participating in firms using higher technology and that these people form a talent base available for employment within the Miami area.

The critical assumptions underlying this view are that (1) industry develops where the resources are, and (2) the resources in the case of the higher technology industries of the type with which we are concerned are highly trained and educated people.

In this same context NASA activity in the state of Florida as a whole

is significant: Within Florida employment by NASA contractors peaked in June of FY 1966 with almost 14,000 persons working on the NASA program at that time. By June of FY 1969 this number is estimated to have dropped to about 9,600. The completion of the Manned Lunar Mission in 1970 will mean that, lacking a substantial recommitment of resources to space by the Chief Executive and Congress, additional large numbers of persons will be in the job stream. Evidence indicates that many of these people are remaining in the state and that a substantial fraction are settling in the Miami-Dade area as one of the most attractive from the standpoint of both living conditions and professional opportunities.

The ramifications of the permanent high-technology base of which we are speaking becomes much more obvious when we take into consideration the time phasing of the contracts in Palm Beach and Broward Counties:

(Figures below in thousands of dollars)

	62-63	64	65	66	67	68	TOTAL
Palm Beach	78,803	26,891	27,673	19,967	18,417	3,007	174,758
Broward	3,037	2,293	3,593	3,450	2,863	1,589	16,825
TOTAL	81,840	29,184	31,266	23,417	21,280	4,596	191,583

As is quite apparent, activity on NASA contracts in the two counties dwindled steadily from the peak period of 1962-1963, and awards in 1968 were less than 6 percent of what they were in the 1962-63 period and some 20 percent of what they were in 1967. Employment of course correspondingly declined. Thus the level for United Aircraft in West Palm Beach dropped from approximately 1,200 persons employed on NASA work in mid-FY 1966 to approximately 200 at the end of FY 1968. There is no doubt that some of these persons were retained by United or other firms in the area--but as assuredly there was significant attrition. However, and this is quite

important, the Federal Information Exchange System (FIX), which collects information on all Federal outlays in the United States by geographic location, indicates that there have been no substantial Federal contract activities in Palm Beach County equal in magnitude to NASA expenditures to set off the down trend. On the other hand, there is evidence of a build-up of higher technology firms in Dade County. The Department of Defense military prime contract procurements in the Miami area had substantially increased as of 1967, when the Federal Information Exchange System reported $179,034,000 of activity. Detailed examination reveals that this activity is primarily with Aerodex, Inc., which recently built up to an employment level of more than 3,500 persons.

More significant is the fact that Social Security Administration statistics indicate an overall increase in the Miami employment in higher technology industry from roughly 7,900 in 1962 to more than 12,500 in 1963, a 59 percent increase. Details are as follows:

DADE COUNTY	NO. EMPLOYEES			TOTAL REPORTING UNITS		
	1962	1967	% Change	1962	1967	% Change
Manufacturing:						
Chemicals	916	1,443	58	88	98	13
Machinery (Except Electr.)	916	1,679	83	81	112	38
Machinery (Electrical)	1,296	2,077	70	57	56	- 2
Transportation (Primarily Aero)	1,838	3,206	74	73	114	56
Professional Instruments	541	578	7	16	23	44
Miscellaneous Services[1] (Technological)	2,371	3,514	48	422	482	14

DADE COUNTY	NO. EMPLOYEES			TOTAL REPORTING UNITS		
	1962	1967	% Change	1962	1967	% Change
TOTALS OF ABOVE CATEGORIES	7,878	12,497	59	737	885	17

[1]This category includes engineers, non-profit educational and scientific research agencies, accountants and autidots, consultants, etc. For exact reference to the makeup of these categories, refer to the Standard Industrial Classification Manual of 1967, Executive Office of the President, Bureau of the Budget, U.S. Government Printing Office.

To us, the observable trend from these statistics is that Miami has developed a number of higher technology industries substantially labor-oriented where skills and training are all important, the main product of which is the capacity to achieve technical results. The fact that this has taken place represents an immediate first step to the broadening of the industrial base and with that substantial social change in Miami.

We feel that NASA will have had a lasting impact on the Miami area if the Miami area continues to develop a relatively large and diverse higher technology capability which provides the Miami area with a competitive advantage in receiving and performance on contracts. Such an establishment would be able to survive changes in the business cycle and changes in technology or in Federal procurement practices, on the one hand, and have the capacity for growth on the other.

So far, we have emphasized NASA's role in having attracted people to the area, but there are, of course, a number of other factors interacting with this that contribute to the development of the area. One, we might point out, is that Miami has become a center for the growing science of oceanography that places a requirement on the community to develop

technologically superior firms that will complement this role. Dante Fascell, U.S. Representative from the 12th Congressional District of Florida, articulated the importance of oceanography in Miami in remarks made for inclusion in the Congressional Record of March 26, 1969:

> The selection of Miami Beach, Fla., as the site of the Marine Technology Society's fifth annual conference . . . is fresh evidence . . . that the Miami area has become a center for the growing science of oceanography--truly Miami is the oceanographic capital of the world . . . .
>
> For years, Miami has attracted oceanographers . . . . Its geographical location and climatic environment are ideal for many oceanographic purposes . . . . It is one of the few . . . areas from which it is possible to study . . . living coral reefs, mangrove swamps, limestone rock formations, and other phenomena . . . .
>
> One of the first organizations to take advantage of these natural conditions was the University of Miami, whose Institute of Marine Sciences now ranks with such other respected marine research and educational institutions as Woods Hole Oceanographic Institute and the Scripps Institute in California. Its outstanding faculty and facilities have helped attract other oceanography-centered organizations to Miami in increasing numbers.
>
> Located within the Institute on Miami's Virginia Key is the Tropical Atlantic Biological Laboratory . . . of the U.S. Bureau of Fisheries . . . . the laboratory is engaged in oceanographic biological research activities . . . ; the design of research programs to support and increase the efficiency of the total catch by the Nation's commercial fisheries; the acquisition of knowledge for use both in harvesting and conserving stocks of surface schooling tunas . . . ; the aiding of the peoples of underdeveloped nations bordering the tropical Atlantic to find better means of acquiring protein rich resources near their shores.
>
> A third major addition to this bustling scientific community will be the Atlantic Oceanographic Laboratories--AOL--of the U.S. Department of Commerce's Environmental Science Services Administration--ESSA-- . . . . Miami was selected as the best location for this laboratory after keen competition among 114 other locations ranging from Maine to the Virgin Islands.
>
> Now occupying rental quarters in the Miami area . . . are five major ESSA components: The Physical Oceanography Laboratory, the Marine Geology and Geophysic Laboratory, the Sea-Air Interaction Laboratory, the National Hurricane Research Laboratory, and the Experimental Meteorology Laboratory. Space is also to be provided in the AOL building for the southern

> regional office of the National Oceanographic Data Center . . . .
>
> . . . In addition, the U.S. Coast and Geodetic Survey ship Discoverer, operated for the ESSA laboratories is already stationed at nearby Dodge Island, and the Survey's ship Researcher, for which construction funds have been appropriated, is nearing completion and will join the Discoverer in Miami early next year . . . .
>
> Thus, when AOL is able to locate on Virginia Key . . . a scientific oceanography community will be formed whose close association will allow many opportunities for mutually advantageous exchanges. The University of Miami supports this concept to the extent that it will move its Institute of Atmospheric Sciences to the key to join the "community" once the ESSA facility is there. In fact, the university plans to erect a special building very shortly, to serve as a center for the Government laboratories as well as the university's own facilities on the key.
>
> These developments are all accomplished or in progress. Of course, Miami's role as the oceanography capital of the world envisions even greater progress in the future. For example, the January, 1969, report of the Commission on Marine Science, Engineering and Resources recommended that a new agency be formed--a National Oceanic and Atmospheric Agency, which would combine and coordinate all of the existing Government functions and more. It would include, among other services, ESSA and the Bureau of Commercial Fisheries. If this recommendation is approved, the basic nucleus of the new Agency's field activities will already be clustered on Virginia Key.
>
> Beyond this, Miamians visualize ultimate creation of a major oceanographic science park on Virginia Key which will be the hub of the international effort to harvest the seas. Such a park would be an outstanding asset for the scientific community. Tied in with a deep water seaport in south Dade County--and including a 25-foot deep channel through Biscayne Bay--this park-port complex would attract a large percentage of the more than 400 national firms with sizable research staffs interested in one phase or another of oceanography, ocean engineering, or the manufacturing of equipment and supplies to support these fields.

Another factor is the good communication and transport facilities developed because of a highly favorable geographical location combined with the large-scale tourist business. In 1967, 9 million passengers and more than 300,000 tons of freight arrived or departed from Miami International Airport. Washington, D.C., New York, Boston, and Chicago are all within the two or three hour range by jet, and in addition, Miami lies on the

most travelled route to Latin America.

In addition, the climatic and recreational amenities of the area can be particularly important when it comes to workers with the skills and training that give them considerable freedom of choice as to location. The record of companies in the aerospace industries in locating their facilities in sunshine states in order to hold technical personnel is famous, and southern Florida definitely fits the same mold.

These and a number of other similar factors depend, however, for their effectiveness on outside forces getting the ball rolling, as it were. Once technologically competent people begin movement toward a place like Miami they tend to continue, and once there they tend, as a group, to generate their own opportunities. Space activities in Florida have gotten this sort of process underway for Miami-Dade. This, we think, constitutes the real impact of the space program on the area.

Perhaps John F. Kennedy was the first to touch upon the nature and possibilities of such an impact when he spoke in Miami on March 10, 1962:

> This is a great state. I am not sure that the people of Florida realize yet what is happening to this state and what will happen in the next ten years. The space age which we take such satisfaction in . . . is going to make the most profound difference to this state. . . . I believe the New Frontier can be captured here in Florida as almost no other State of the Union . . . . In one of the most amazing prophecies in history a hundred years ago, Jules Verne prophesized that there would be a competition between Florida and Texas as to which state would be the source of vitality in the space age. He thought that Florida might fail because there was no city large enough, and he wondered whether Florida was stable enough, linked to the United States, to stand the blast which would come when we finally put a man in space. One hundred years ago! Well, I prophesy in the next ten years that this State is going to have the greatest period of development of any state in the United States--and you, the people of Florida, must be part of it.